# REEL MEMBERS AND FILM WINDING METHODS

## FIELD OF THE INVENTION

The present invention relates to the technique of winding a long continuous film such as an anisotropic conductive adhesive film or an insulating adhesive film, for example.

## PRIOR ART

Generally, an anisotropic conductive adhesive film or an insulating adhesive film is used to electrically connect electronic components such as liquid crystal panels or IC chips to each other, for example.

Such adhesive films are delivered to clients in the form of rolls of the films wound around reel members finished through certain preparation processes.

Recently, further longer adhesive films are desired from the client side.

However, longer adhesive films involve greater roll diameters, which cause a higher stress to be generated in the adhesive films with the result that adhesive may be squeezed out of the adhesive films.

The present invention was made to solve these technical problems with the purpose of providing a method for winding a long adhesive film at multiple stages in such a diameter that adhesive cannot be squeezed out and a reel member that can be applied to this method.

## SUMMARY OF THE INVENTION

The present invention provides a reel member comprising a winding spool around which a given film can be wound and a plurality of flanges mounted on the winding spool, wherein each of the flanges has a guide groove for passing the film between winding spools adjacent to each other. By using the reel member of the present invention, the film can be smoothly moved from a winding spool on one side to a winding spool on the other side by

passing the film through the guide groove at the stage when winding of the film around the winding spool on the one side has been completed.

In the reel member of the present invention, an engaging part capable of engaging with the film is advantageously formed in the guide groove.

Thus, the film can be wound around a winding spool on the other side by catching the film at the engaging part in the guide groove when it is passed through the guide groove.

In the reel member of the present invention, a retaining part capable of retaining the film is advantageously formed in the guide groove.

Thus, the film can be wound around a winding spool on the other side without slack by retaining the film at the retaining part in the guide groove when it is passed through the guide groove.

In the reel member of the present invention, the guide grooves are advantageously opposed to each other.

Thus, the film can be axially moved or caught at the same timing between flanges.

In the reel member of the present invention, the outer diameter of the flange is advantageously determined on the basis of the value of the stress generated in the film wound around the winding spool.

This ensures that the film can be wound without running off the outer periphery of the flange, whereby the adhesive cannot be squeezed out.

In the reel member of the present invention, the winding spools are advantageously axially connectable to each other.

Thus, a long film can be handled as appropriate by adjusting the number of reel members depending on the length of the film.

The present invention also provides a reel member comprising a winding spool around which a given film can be wound and a plurality of flanges mounted on the winding

spool and having an engaging projection capable of engaging with the film on the outer periphery.

The reel member of the present invention has the advantage that not only the film can be smoothly moved from a winding spool on one side to a winding spool on the other side or can be caught at the engaging projection but also the range of the timing of performing this can be wider.

In the reel member of the present invention, the engaging projections are advantageously opposed to each other.

Thus, the film can be axially moved or caught at the same timing between flanges.

The present invention also provides a reel member comprising a winding spool around which a given film can be wound and a flange mounted on the winding spool and having an engaging projection capable of engaging with the film on the outer periphery, wherein the winding spools are axially connectable to each other.

The present invention also provides a reel member comprising a winding spool around which a given film can be wound and a flange mounted on the winding spool and having a guide groove for passing the film, wherein the winding spools are axially connectable to each other.

The present invention also provides a reel member assembly formed of a plurality of reel members connected to each other, each reel member comprising a winding spool around which a given film can be wound and a flange mounted on the winding spool and having a guide groove for passing the film wherein the winding spools are axially connectable to each other.

According to the present invention wherein the winding spools are axially connectable to each other, a long film can be handled as appropriate by adjusting the number of reel members depending on the length of the film.

The present invention also provides a film package comprising a reel member assembly formed of a plurality of reel members connected to each other, each reel member comprising a winding spool around which a given film can be wound and a flange mounted on the winding spool and having a guide groove for passing the film wherein the winding spools are axially connectable to each other and wherein a continuous film is wound around the winding spool of the reel member assembly.

According to the film package of the present invention, a long film can be easily handled at the market.

In the film package of the present invention, an empty winding spool is advantageously interposed between winding spools around which the film is wound.

The present invention also provides a reel member comprising a plurality of winding spools coaxially arranged at predetermined intervals and a flange mounted at each end of each winding spool wherein a guide groove is cut away from each flange at a given center angle and the guide grooves are arranged with a phase shift of the center angle.

According to the reel member of the present invention, the center of gravity of the reel member as a whole can be located on the winding axis so that a long film can be wound always at a constant torque and can be guided between opposed guide edges in the guide grooves adjacent to each other to the next winding spool.

In the reel member of the present invention, a spacer spool for guiding the film is advantageously inserted between the winding spools.

Thus, the film can be guided along the side face of the spacer spool to the next winding spool and the film can be gently passed by selecting the length of the spacer spool.

In the reel member of the present invention, the opposed guide edges in the guide grooves adjacent to each other are advantageously chamfered at a given angle.

Thus, the film can be smoothly guided to the next winding spool along the chamfered bevel of the flange.

The present invention also provides a film package comprising a reel member comprising a plurality of winding spools coaxially arranged at predetermined intervals and a flange mounted at each end of each winding spool and having a guide groove cut away from each flange at a given center angle and the guide grooves are arranged with a phase shift of the center angle wherein a continuous film is wound around the reel member.

The film used in the film package of the present invention is preferably an insulating adhesive film or an anisotropic conductive adhesive film.

In the film package of the present invention, the film advantageously comprises an adhesive applied on a release film and the release film is exposed at a necessary part for passing the film from one to the other side of the flange.

This has the advantage that not only the insulating adhesive film or anisotropic conductive adhesive film can be saved but also the quality of the insulating adhesive film or anisotropic conductive adhesive film can be guaranteed to clients who avoid using kinks when the film is passed.

The present invention also provides a method for winding a continuous film drawn out from the feeding side onto a winding shaft at multiple stages, comprising the steps of:

winding a given part of the film onto a part of the winding shaft by rotating the winding shaft at a given speed, and then

winding the given part of the film onto another part of the winding shaft by stopping or slowing the rotation of the winding shaft and axially moving the winding shaft relative to the feeding side.

According to the method for winding a film of the present invention, a long film can be wound at multiple stages within a desired limited roll diameter of the film, and especially an insulating adhesive film or anisotropic conductive adhesive film can be wound at multiple stages within such a roll diameter that the adhesive cannot be squeezed out.

The present invention also provides a method for winding a continuous film drawn out from the feeding side onto a winding shaft at each part of the winding shaft divided by flanges, comprising the steps of:

winding a given part of the film onto a part of the winding shaft by rotating the winding shaft at a given speed, and then

winding the given part of the film on another part of the winding shaft after passing the film over the flange by stopping or slowing the rotation of the winding shaft and axially moving the winding shaft relative to the feeding side.

According to the method for winding a film of the present invention, a long film can be wound at multiple stages within a limited diameter even when a reel member having a plurality of flanges on the winding axis is used.

The present invention also provides a method for winding a continuous film using a reel member comprising a winding spool and a plurality of flanges mounted on the winding spool and having a guide groove for passing the film between winding spools adjacent to each other, comprising the step of winding the film on a winding spool and then the next winding spool with at least one empty winding spool being interposed.

According to the method for winding a film of the present invention, a film can be wound at multiple stages while it is passed over the flange without folding.

The present invention also provides a method for winding a continuous film using a reel member comprising a plurality of winding spools coaxially arranged at predetermined intervals, and a flange mounted at each end of each winding spool and having a guide groove cut away from each flange at a given center angle and arranged with a phase shift of the center angle, the method comprising the step of shifting the timing of axially moving the winding spools by the center angle of the guide groove.

According to the method for winding a film of the present invention, the weight can be evenly balanced and a film can be smoothly passed while it is spirally guided.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 (a) is a front view showing the outline structure of a reel member according to a first embodiment of the present invention and FIG. 1 (b) is a right side view showing the outline structure of the reel member.

FIG. 2 (a) is a left side view showing the outline structure of a reel member according to a second embodiment of the present invention, FIG. 2 (b) is a front view showing the outline structure of the reel member, FIG. 2 (c) is a right side view showing the outline structure of the reel member and FIG. 3 is a front view showing that such reel members are connected.

FIG. 4 (a) is a front view showing the outline structure of a reel member according to a third embodiment of the present invention and FIG. 4 (b) is a right side view showing the outline structure of the reel member.

FIG. 5 (a) is a front view showing the outline structure of a reel member according to a fourth embodiment of the present invention and FIG. 5 (b) is a right side view showing the outline structure of the reel member.

FIG. 6 (a) is a front view showing the outline structure of a reel member according to a fifth embodiment of the present invention, FIG. 6 (b) is a right side view showing the outline structure of the reel member and FIG. 7 is a front view showing that such reel members are connected on a shaft.

FIG. 8 (a) is a front view showing the outline structure of a reel member according to a sixth embodiment of the present invention, FIG. 8 (b) is a plan view showing the outline structure of the reel member and FIG. 8 (c) is an enlarged view of a retaining groove of the reel member.

FIG. 9 (a) is a front view showing the outline structure of a reel member according to a seventh embodiment of the present invention and FIG. 9 (b) is an enlarged view of a retaining groove of the reel member.

FIG. 10 is a front view showing the outline structure of a reel member according to an eighth embodiment of the present invention.

FIG. 11 (a) is a front view showing the outline structure of a reel member according to a ninth embodiment of the present invention and FIG. 11 (b) is an enlarged view of a part of a retaining groove of the reel member.

FIG. 12 (a) is a front view showing the outline structure of a reel member according to a tenth embodiment of the present invention and FIG. 12 (b) shows the positional relationship between guide grooves in the flanges of the reel member.

FIG. 13 (a) is a right side view of the reel member taken along S1-S1 line of Fig. 12(a), FIG. 13 (b) is a right side view of the reel member taken along S2-S2 line, FIG. 14 is a diagram for illustrating the bevel angle of the reel member, FIG. 15 is a front view showing a film package comprising a film wound around the reel member, and FIG. 16 shows the reel member disassembled into several components.

FIG. 17 is a front view showing the outline structure of an example of a multistage winding system for carrying out a method for winding a film according to the present invention, FIG. 18 is a left side view showing the outline structure of the multistage winding system.

FIG. 19 (a) and Fig. 19(b) show how a film is wound around a reel member of the present invention according to a method for winding a film of the present invention.

FIG. 20(a) and Fig. 20(b) show how a film is wound around a reel member of the present invention according to a method for winding a film of the present invention.

FIG. 21(a) and Fig. 21(b) show how a film is wound around a reel member of the present invention according to a method for winding a film of the present invention.

FIG. 22(a) and Fig. 22(b) show how a film is wound around a reel member of the present invention according to a method for winding a film of the present invention.

FIG. 23(a) and Fig. 23(b) show how a film is wound around a reel member of the present invention according to a method for winding a film of the present invention.

FIG. 24(a) and Fig. 24(b) show how a film is wound around a reel member of the present invention according to a method for winding a film of the present invention.

FIG. 25 (a) is a left side view showing an embodiment of a film package of the present invention and FIG. 25 (b) is a front view showing the film package.

FIG. 26 is a front view showing another embodiment of a film package of the present invention.

FIG. 27 shows how a film is wound around another reel member of the present invention according to a method for winding a film of the present invention.

FIG. 28 shows how a film is wound around another reel member of the present invention according to a method for winding a film of the present invention.

FIG. 29 shows how a film is wound around another reel member of the present invention according to a method for winding a film of the present invention.

FIG. 30 shows how a film is wound around another reel member of the present invention according to a method for winding a film of the present invention.

Various numeral references represent the following elements: 50(A-H, K, L), reel member; 51(A-H, K, L), flange; 52(A-H, K, L), winding spool; 520L, spacer spool; 53(A-C, E, F, G, H, K, L), guide groove; 54(A-H), guide edge; 54L, guide edge; 56(D), engaging projection; 57(F, G, H, K), retaining groove; 60(B, C, E, K), reel member assembly; 70(A, B, C), film package.

## THE MOST PREFERRED EMBODIMENTS OF THE INVENTION

Reel members of the present invention are used to wind a continuous long film at multiple stages.

Films used in the present invention are advantageously, but not limited to, insulating adhesive films or anisotropic conductive adhesive films, especially for electrically connecting electrodes of circuit boards to electrodes of IC chips.

Insulating adhesive films here comprise an insulating adhesive formed as a film on a release film. Anisotropic conductive adhesive films are similar films except that the adhesive contains conductive particles.

Now, preferred embodiments of reel members capable of winding such insulating adhesive films and anisotropic conductive adhesive films (hereinafter sometimes referred to as simply "films") are explained with reference to the attached drawings.

In the films used in the following embodiments, the adhesive is removed at predetermined intervals to partially expose the release film.

FIG. 1 (a) is a front view showing the outline structure of a reel member according to a first embodiment of the present invention and FIG. 1 (b) is a right side view showing the outline structure of the reel member.

As shown in FIG. 1 (a) and (b), reel member 50A according to the present embodiment is integrally formed of e.g., a resin and comprises a winding spool 52A and a plurality of flanges 51A.

Flanges 51A are formed as discs having a given outer diameter and arranged in parallel to each other at predetermined intervals on cylindrical winding spool 52A.

The insulating adhesive film or anisotropic conductive adhesive film used here not shown comprises adhesive films of a predetermined length (e.g., 25 m) repeatedly formed at predetermined intervals on a release film depending on the film width (e.g., 1.9 mm) or film

thickness (e.g., 0.1 mm) in order that adhesive cannot be squeezed out of the release film under the stress generated during winding.

Each interval between adhesive films, i.e., each exposed length of the release film, is determined within a minimum range necessary for passing the film in the direction of the winding spool in order to save the adhesive film during winding at multiple stages.

To adapt reel member 50A according to the present embodiment to such a film, the number of flanges 51A is determined depending on the repetition number of the adhesive films and each interval between flanges 51A is determined to be somewhat greater than the film width. The outer diameter of flange 51A is determined to be greater than the roll diameter depending on the length of the adhesive film in order to protect the rolled film.

As shown in FIG. 1 (b), each flange 51A has a guide groove 53A of the same shape for passing the film to another flange 51A adjacent thereto. Guide grooves 53A are each cut away in an approximately sectorial shape to only partially expose the rolled film and axially aligned in opposite to guide grooves 53A in flanges 51A adjacent thereto.

Thus, a guide edge 54A formed on the outer periphery of each guide groove 53A comes into contact with the film at the same position as the other guide edges 54A in the circumferential direction of flange 51A.

Winding spool 52A is formed in a length depending on the number of flanges 51 or the interval therebetween. Winding spool 52A has an axially running through-hole 55A of a given cross section, and the through-hole 55A has a shape in which can be fitted e.g., a keyed shaft not shown in the present embodiment.

FIG. 2 (a) is a left side view showing the outline structure of a reel member according to a second embodiment of the present invention, FIG. 2 (b) is a front view showing the outline structure of the reel member and FIG. 2 (c) is a right side view showing the outline structure of the reel member. FIG. 3 is a front view showing that such reel members are connected.

As shown in FIG. 2(a) to FIG. 2(c), reel member 50B according to the present embodiment comprises a winding spool 52B and a flange 51B integrally formed with each other.

In the case of the present embodiment, flange 51B differs from flange 51A of the first embodiment in the shape of guide groove 53B. That is, this guide groove 53B is formed in a shape radially extending to the vicinity of winding spool 52B in a width greater than the film width.

Winding spool 52B comprises a spool segment $52B_1$ having a length somewhat greater than the film width and an insert segment $52B_2$ coaxial with spool segment $52B_1$ with flange 51B interposed therebetween, wherein insert segment $52B_2$ is in the form of a keyed cylinder while spool segment $52B_1$ has a bore having a key groove in which can be fitted insert segment $52B_2$.

Thus, a reel member 50B is axially connected to another reel member 50B having the same structure so that guide grooves 53B in flanges 51B of both members are axially aligned in opposite to each other.

Winding spool 52B has a through-hole 55B in the same manner as in the previous embodiment. In the present embodiment, this through-hole 55B has a form in which can be fitted a shaft having a cross section in the form of a letter "D".

As shown in FIG. 3, e.g., four such reel members 50B are connected to form a reel member assembly 60B wherein winding spools 55B are combined into one winding spool and flanges 51B are arranged in parallel to each other.

FIG. 4 (a) is a front view showing the outline structure of a reel member according to a third embodiment of the present invention and FIG. 4 (b) is a right side view showing the outline structure of the reel member.

As shown in FIGS. 4(a) and (b), reel member 50C according to the present embodiment comprises a winding spool 52C and two flanges 51C integrally formed with each other.

In the case of the present embodiment, flanges 51C are identical with flanges 51B of the second embodiment and arranged in parallel to each other on winding spool 52C.

Winding spool 52C has the same structure as that of winding spool 52B of the second embodiment except that it differs from the second embodiment in length because two flanges 51B are provided.

As shown in FIG. 3, e.g., two such reel members 50C are connected to form a reel member assembly 60C in the same manner as in the second embodiment.

FIG. 5 (a) is a front view showing the outline structure of a reel member according to a fourth embodiment of the present invention and FIG. 5 (b) is a right side view showing the outline structure of the reel member.

As shown in FIG. 5(a) and (b), reel member 50D according to the present embodiment comprises a winding spool 52D and a flange 51D integrally formed with each other.

In the case of the present embodiment, flange 51D differs from flanges 51A to 51C of the first to third embodiments in that it has no guide groove. That is, this flange 51D is formed by gradually increasing the radius of a part of the outer periphery of flange 51A to 51C of the previous embodiments into an arc having an engaging projection 56D having a guide edge 54D capable of coming into contact with the film at the part where the difference in radius is maximum.

Winding spool 52D has the same structure as that of winding spool 52B of the second embodiment.

FIG. 6 (a) is a front view showing the outline structure of a reel member according to a fifth embodiment of the present invention and FIG. 6 (b) is a right side view showing the

outline structure of the reel member. FIG. 7 is a front view showing that such reel members are connected on a shaft.

As shown in FIG. 6 (a) and (b), reel member 50E according to the present embodiment comprises a winding spool 52E and a pair of flanges 51E integrally formed with each other.

In the case of the present embodiment, flanges 51E have the same structure as that of flanges 51C of the third embodiment.

On the other hand, winding spool 52E has a through-hole 55E having a circular cross section with a key groove in the same manner as in the first embodiment.

As shown in FIG. 7, plurality of such reel members 50E are connected on a shaft by e.g., adhesion to form a reel member assembly 60E.

FIG. 8 (a) is a front view showing the outline structure of a reel member according to a sixth embodiment of the present invention, FIG. 8 (b) is a plan view showing the outline structure of the reel member and FIG. 8 (c) is an enlarged view of a retaining groove of the reel member.

As shown in FIG. 8(a) to FIG. 8(c), reel member 50F according to the present embodiment comprises a winding spool 52F and a flange 51F integrally formed with each other.

Flange 51F of the present embodiment has a guide groove 53F similar to the guide groove in flange 51A of the first embodiment except for additional features as follows.

That is, flange 51F has a thickness of 5 mm to 6 mm to protect the film against folding when it is passed on guide edge 54F in guide groove 53F and the part including this guide edge 54F has a convex cross section so that guide edge 54F is curved.

Flange 51F also has a retaining groove 57F for retaining the film to prevent slack when the film is passed to another reel member.

This retaining groove 57F has a width somewhat smaller than the thickness of the film and extends in a direction approximately orthogonal to the radial direction of flange 51F from the corner of guide groove 53F on guide edge 54F.

Winding spool 52F has the same structure as that of winding spool 52B of the second embodiment.

FIG. 9 (a) is a front view showing the outline structure of a reel member according to a seventh embodiment of the present invention and FIG. 9 (b) is an enlarged view of a retaining groove of the reel member.

As shown in FIG. 9 (a) and (b), reel member 50G according to the present embodiment comprises a winding spool 52G and a flange 51G integrally formed with each other.

Flange 51G of the present embodiment is similar to flange 51F of the sixth embodiment except that it has a retaining groove 57G different from retaining groove 57F of the sixth embodiment.

Retaining groove 57G has a leading groove $57G_1$ extending to the proximity of the center of flange 51G from the corner of guide groove 53G on guide edge 54G. This retaining groove 57G has a width greater than the thickness of the film. Leading groove $57G_1$ in guide groove 53G A terminates in circular retaining hole $57G_2$ having a diameter somewhat greater than the width of the film.

A projecting anchor $57G_3$ is formed near retaining hole $57G_2$ in leading groove $57G_1$ so that the width of leading groove $57G_1$ is smaller than the thickness of the film.

Winding spool 52G has the same structure as that of winding spool 52B of the second embodiment.

FIG. 10 is a front view showing the outline structure of a reel member according to an eighth embodiment of the present invention.

As shown in FIG. 10, reel member 50H according to the present embodiment comprises a winding spool 52H and a flange 51H integrally formed with each other.

In the case of the present embodiment, flange 51H has a plurality of guide grooves 53H. These guide grooves 53H are formed at regular intervals on the outer periphery of flange 51H at the same center angle to locate the center of gravity of flange 51H itself on winding spool 52H to keep a balance.

Retaining groove 57H is also formed in the same shape on the same position in each guide groove 53H. Each retaining groove 57H has a width relatively greater than the thickness of the film and extends in one direction from a corner of guide groove 53H and turns in a radial direction in a width somewhat smaller than the thickness of the film.

Winding spool 52H has the same structure of winding spool 52B of the second embodiment.

FIG. 11 (a) is a front view showing the outline structure of a reel member according to a ninth embodiment of the present invention and FIG. 11 (b) is an enlarged view of a part of a retaining groove of the reel member.

As shown in FIG. 11 (a) and (b), reel member 50K according to the present embodiment comprises a winding spool 52K and a plurality of flanges 51K integrally formed with each other.

In the case of the present embodiment, flanges 51K are formed in the shape of a sector having the same center angle and arranged at regular intervals on the outer periphery of winding spool 52K to keep a balance similarly to the previous embodiment. These flanges 51K form guide grooves 53K between flanges 51K and have a guide edge 54K on one edge of each flange 51K.

Retaining groove 57K comprises a first retaining groove $57K_1$ running from a corner of each guide groove 53K into flange 51K to extend into the winding direction of

winding spool 52K and further incise winding spool 52K and a second retaining groove $57K_2$ formed on the edge of another flanges 51K opposed to guide edge 54K.

This second retaining groove $57K_2$ is formed to extend in a direction reverse to the winding direction on the same circumference having the roll diameter of the film.

Winding spool 52K has the same structure as that of winding spool 52B of the second embodiment except that it is partially incised by retaining groove $57K_1$.

FIG. 12 (a) is a front view showing the outline structure of a reel member according to a tenth embodiment of the present invention and FIG. 12 (b) shows the positional relationship between guide grooves in the flanges of the reel member. FIG. 13 (a) is a right side view of the reel member taken along S1-S1 line and FIG. 13 (b) is a right side view of the reel member taken along S2-S2 line. FIG. 14 is a diagram for illustrating the bevel angle of the reel member.

As shown in FIG. 12(a), reel member 50L according to the present embodiment comprises winding spools 52L and spacer spools 520L and plurality of flanges 51L integrally formed with each other. Here, a plurality of winding spools 52L and spacer spools 520L are alternately arranged.

The outer diameter and the length of spacer spool 520L are determined on the basis of given conditions described below provided that they are greater than the outer diameter and the length of winding spool 52L.

Each flange 51L has a guide groove 53L cut away in the form of a sector at a given center angle.

Here, the weight of reel member 50L as a whole is evenly balanced with respect to the winding axis by selecting the center angle $\theta$ of guide groove 53L to be 360 degrees/n ("/" means a ratio) and phase-shifting guide grooves 53L at intervals of this center angle $\theta$ provided that n means the unit number of flanges 51L forming reel member 50L.

When the unit number n of flanges 51L is 4, for example, the center angle $\theta$ of guide groove 53L is 90 degrees and accordingly the total number of flanges 51L is an integral multiple of the unit number n (here 8) as shown in FIG. 12 (a), (b).

When flanges are successively designated as $51L_1(1)$ to $51L_8(8)$ from the side of the sliding direction X+ of the winding shaft, flanges $51L_1(1)$, $51L_5(5)$ have guide grooves $53L_1$, $53L_5$ (shown by hatched areas with dashed lines) in a zone of 0-90 degrees; flanges $51L_2(2)$, $51L_6(6)$ have guide grooves $53L_2$, $53L_6$ (shown by hatched areas with solid lines) in a zone of 90-180 degrees; flanges $51L_3(3)$, $51L_7(7)$ have guide grooves $53L_3$, $53L_7$ (shown by hatched areas with solid lines) in a zone of 180-270 degrees; and flanges $51L_4(4)$, $51L_8(8)$ have guide grooves $53L_4$, $53L_8$ (shown hatched areas with dashed lines) in a zone of 270-360 degrees in a rotating coordinate system (winding direction R is positive) as shown in the right side view.

By this arrangement of guide grooves, the centers of gravity of flanges 51L themselves are as follows. For the centers of gravity of flanges 51L, flanges $51L_1(1)$, $51L_5(5)$ are symmetrical to the flanges $51L_3(3)$, $51L_7(7)$ with respect to the winding axis and the flanges $51L_2(2)$, $51L_6(6)$ are symmetrical to the flanges $51L_4(4)$, $51L_8(8)$ with respect to the winding axis, so that the center of gravity of reel member 53L as a whole is located on the winding axis.

Downstream guide edges $54L_2$, $54L_4$, $54L_6$ in the winding direction R of flanges $51L_2(2)$, $51L_4(4)$, $51L_6(6)$ on the feeding side are opposed at the same plane to upstream guide edges $54L_3$, $54L_5$, $54L_7$ in the winding direction R of flanges $51L_3(3)$, $51L_5(5)$, $51L_7(7)$ on the receiving side.

In the case of the present embodiment, guide edges $54L_2$, $54L_4$, $54L_6$ on the feeding side and guide edges $54L_3$, $54L_5$, $54L_7$ on the receiving side are further chamfered at a given angle to form bevels parallel to each other in order that the film cannot be folded when it is passed.

For example, guide edge $54L_2$ of flange $51L_2(2)$ has a guide bevel $58L_2$ downwardly inclined from the horizontal plane including the winding axis and guide edge $54L_3$ of flange $51L_3(3)$ has a guide bevel $58L_3$ upwardly inclined from the horizontal plane including the winding axis, as shown in FIG. 13 (a), (b) and FIG. 12 (a).

The other guide edges $54L_4$, $54L_6$ on the feeding side and guide edges $54L_5$, $54L_7$ on the receiving side are also designed in the same manner.

Referring now to FIG. 14, the bevel angles $\alpha$ of guide edges 54L are explained.

When the film is passed from the outermost turn of the film wound around winding spool $52L_1$ to the next winding spool $52L_2$ via spacer spool $520L_1$, such a film preferably follows a spiral curve on a specific cylindrical surface because it need be guided without folding.

In the case of the present embodiment, it will be described for the region including flanges $51L_1$ to $51L_4$, and winding spools $52L_1$, $52L_2$ and spacer spool $520L_1$ between them in whole of the reel member 50L. A virtual cylindrical surface C including lines L2, L3 as the outermost generatrices and imaginarily integral with the side face of spacer spool 520L provided that L1 is the uppermost generatrix on a film 2 having a roll diameter D; L2 is a line tangent to the floating part of the film 2 when it is passed from the intersection P1 between the inner face of flange $51L_1$ and L1; and L3 is a line drawn from the intersection P2 between the inner face of flange $51L_4$ and the lowermost generatrix on winding spool $52L_2$ in parallel with line L2.

Then, a trajectory of the film edge S1 connecting the intersection P1 with a point P3 distant from the intersection P2 by the film width on the line L3 to form a spiral curve and a trajectory of the film edge S2 connecting the intersection P2 with a point P4 distant from the intersection P1 by the film width on the line L2 to form a spiral curve are supposed on the virtual cylindrical surface C.

The bevel angle $\alpha 3$ of flange $51L_3$ is determined in such a manner that guide bevel $58L_3$ may be tangent with the trajectory of the film edge S2. The bevel angle $\alpha 2$ of flange $51L_2$ is the same as the bevel angle $\alpha 3$ of flange $51L_3$.

The bevel angles $\alpha 1$, $\alpha 4$-$\alpha 8$ of the other flanges $51L_1$, $51L_4$-$51L_8$ are also the same as the bevel angle $\alpha 3$ of flange $51L_3$.

Guide bevel $58L_2$ of flange $51L_2$ may be or may not be tangent with the trajectory of the film edge S1 depending on the relation with the length d of spacer spool $520L_1$.

When the length d1 of spacer spool $520L_1$ is selected in such a manner that guide bevel $58L_2$ may not be tangent with the trajectory of the film edge S1 as in the present embodiment, the film can be advantageously gently passed because the pitch angle of the spiral curve increases with the increased virtual cylindrical surface C along with a film-guiding space defined by the length d1 of spacer spool $520L_1$, upstream guide edge $54L_2$ of flange $51L_2$ and downstream guide edge $54L_3$ of flange $51L_3$ at an angle of 180 degrees with the upstream guide edge.

When the length d2 (<d1) of spacer spool $520L_1$ is selected in such a manner that guide bevel $58L_2$ may be tangent with the trajectory of the film edge S1 contrary to the present embodiment, the winding slack can be advantageously prevented by guiding both edges of the film simultaneously along guide bevel $58L_3$ of flange $51L_3$ and guide bevel $58L_2$ of flange $51L_2$ though the film is steeply passed because the film guiding space becomes smaller.

FIG. 15 is a front view showing a film package comprising a film wound around a reel member according to the present embodiment.

As shown in FIG. 15, this film package 70C is obtained by applying a method for winding a film described below to a reel member 50L according to the present embodiment wherein film 2 is passed in a curve close to a spiral curve in contact with guide bevels $58L_3$, $58L_5$ and $58L_7$.

However, film 2 can be passed in a curve further closer to the trajectories of the film edge S1, S2 if the end face of (unchamfered) guide edge 54L or the side face of spacer spool 520L at least in contact with film 2 is closer to virtual cylindrical surface C.

FIG. 16 shows a reel member according to the present embodiment disassembled into several components.

The reel member 50L described above is integrally formed, but reel member 50L according to the present embodiment can also be assembled from a plurality of components.

For example, a first component 501L comprises flange $51L_1$ and winding spool $51L_1$, a second component 502 comprises flange $51L_8$, and a third component 503L consists of flange $51L_2$ and flange $51L_3$ together with spacer spool $520L_1$ and winding spool $52L_2$, and component 501L and component 503L are connectable to each other while component 503L and component 502L are connectable to each other, as shown in FIG. 16.

In such a reel member 50L, the unit number n of flanges 51L can be selected as any integral multiple by connecting components 501L-503L with a phase shift of 90 degrees.

Guide grooves $53L_1$, $53L_8$ are formed in flanges $51L_1(1)$, $51L_8(8)$ in the present embodiment to evenly balance the weight, but they are basically unnecessary for passing a film.

Thus, flange 51L without guide groove 53L can be provided on each outer side of an array of any integral multiple of the unit number n of flanges 51L having guide groove 53L in order to evenly balance the weight and protect the film.

In carrying out a method for winding a film according to the present invention, a multistage winding system as shown below is used, for example. This multistage winding system is first explained with reference to the drawings.

FIG. 17 is a front view showing the outline structure of an example of a multistage winding system for carrying out a method for winding a film according to the present

embodiment. FIG. 18 is a left side view showing the outline structure of the multistage winding system.

As shown in FIG. 17 or FIG. 18, multistage winding system 1 according to the present embodiment comprises a feeding apparatus 10 and a winding apparatus 20.

Feeding apparatus 10 is designed to apply a given load on reel member 11 around which a given film 2 has been wound while reel member 11 is rotatably supported on feeding shaft 12.

Reel member 11 of feeding apparatus 10 has the approximately same structure as those of reel members 50 according to the first to fifth embodiments described above except that the outer diameter of flange 13 is determined to be greater than the outer diameters of flanges 51 of the previous embodiments depending on the overall length of the insulating adhesive film or anisotropic conductive adhesive film.

Winding apparatus 20 comprises a winding mechanism 30, a moving mechanism 40 and a controller 60.

Winding mechanism 30 comprises a winding shaft 31 parallel to feeding shaft 12 of feeding apparatus 10.

This winding shaft 31 is designed to be fitted into the through-hole in winding spool 51 of reel member 50 according to the embodiments described above with a slight gap, thereby supporting reel member 50 in such a manner that it can be axially moved while it is fixed against circumferential movement.

At one end of such winding shaft 31 is provided a driving member 32. This driving member 32 is designed to transmit the power of a winding motor 32c comprising a stepping motor to a gear 32a fixed to winding shaft 31 through a train of gears 32b to rotate winding shaft 31.

An encoder 32d is fixed to the driving shaft of winding motor 32c and a light reflective sensor 32e is provided near the encoder 32d.

Such winding motor 32c and sensor 32e are electrically connected to controller 60. This controller 60 is designed to count the number of pulses of winding motor 32c on the basis of signals from sensor 32e and to control the rotation of winding motor 32c on the basis of the number of pulses.

Moving mechanism 40 comprises a pair of driving shafts 41 having an external screw parallel to winding shaft 31 and a slide shaft 42. At one end of driving shaft 41 is provided a driving member 43 having the same structure as that of the driving member of winding mechanism 30. That is, this driving member 43 comprises a slide motor 43b rotating driving shaft 41 by transmitting power to a gear 43a on driving shaft 41 and a light transmissive sensor 43d capable of detecting an encoder 43c on driving shaft 41. These slide motor 43b and sensor 43d are connected to controller 60 so that they are controlled in the same manner as winding mechanism 30.

A moving plate 44 and a pressing plate 45 are mounted on these driving shaft 41 and slide shaft 42. Moving plate 44 is screwed to driving shaft 41 and slidably engaged with slide shaft 42. Pressing plate 45 is not screwed to driving shaft 41 and designed to be biased toward moving plate 44 by a coil spring not shown while it is slidably engaged with only slide shaft 42.

Both moving plate 44 and pressing plate 45 are in the form of e.g., a ring so that they may come into contact with only the outer periphery of flange 51 of reel member 50.

Next, a preferred embodiment of a method for winding a film according to the present invention is explained referring to examples in which some of reel members 50A to 50L according to the first to tenth embodiments are applied to the multistage wining system 1 described above.

FIG. 19 to FIG. 24 are left side views and front views showing how a film is wound around a reel member of the present invention according to a method for winding a film of the present embodiment.

FIG. 25 (a) is a left side view showing a film package according to the present embodiment and FIG. 25 (b) is a front view showing the film package.

As shown in FIG. 17, a reel member 11 around which a film 2 has been wound is first mounted on a feeding apparatus 10 and e.g., a reel member 50A according to the first embodiment is mounted on a winding apparatus 20, and then reel member 50A on the winding side is positioned with respect to reel member 11 on the feeding side in such a manner that the flange 51A on the side of moving plate 44 of winding apparatus 20 (the rightmost flange in FIG. 17) and the flange 13 at the right of feeding apparatus 10 (hereinafter referred to as "right flange 13a") are coplanar.

Then, film 2 drawn from reel member 11 on the feeding side is wound around winding spool 51A of reel member on the winding side. Here, flanges 51A of reel member 50A are designated as first flange $51A_1$, second flange $51A_2$, third flange $51A_3$ and fourth flange $51L_4$ successively from the right side and winding spools 52A of reel member 50A are designated as first winding spool $52A_1$ between first and second flanges $51A_1$, $51A_2$, second winding spool $52A_2$ between second and third flanges $51A_2$, $51A_3$ and third winding spool $52A_3$ between third and fourth flanges $51A_3$, $51A_4$ as shown in FIG. 1 (a) for convenience of explanation.

Under a command from controller 60 described above, winding motor 32C is activated to start the rotation of winding shaft 31 and also start to count the number of pulses of winding motor 32C.

Thus, reel member 50A winds film 2 tensioned under a load from feeding apparatus 10 onto first winding spool $52A_1$ (see FIG. 19 (a), (b)).

Controller 60 stops the operation of winding motor 32c when it judges from the count of the number of pulses of winding motor 32c that the entry 2b of release film 2a at the point that the release film on the feeding side in contact with rolled film 2 on the winding side is on the point of entering into guide groove 53A of second flange $51A_2$ after first winding

spool $52A_1$ of reel member 50A has finished winding adhesive film 2 and started to wind release film 2a, as shown in FIG. 20 (a), (b).

Under a command from controller 60, slide motor 43b is operated for a time corresponding to a given number of pulses to rotate driving shaft 41. Thus, reel member 50A moves until second flange $51A_2$ reaches a distance over the position of right flange 13a on the feeding side along winding shaft 31, as shown in FIG. 21 (a), (b). In this case, release film 2a on the feeding side is twisted against rolled film 2 on the winding side so that release film 2a runs off from guide groove 53A of second flange $51A_2$ to approach third flange $51A_3$.

When reel member 50A is rotated again in this state, second flange $51A_2$ catches release film 2a at guide edge 54A, as shown in FIG. 22 (a), (b).

As reel member 50A rotates, it then winds release film 2a around second winding spool $52A_2$ while it is caught by second flange $51A_2$ and after a while, feeding of release film 2a is finished and the next adhesive film 2 is sent and wound, as shown in FIG. 23 (a), (b).

Under a command from controller 60, slide motor 43b is also operated to return reel member 50A until second flange $51A_2$ becomes coplanar with right flange 13a on the feeding side.

Thus, reel member 50A winds film 2 from the feeding side in parallel to second winding spool $52A_2$, as shown in FIG. 24 (a), (b).

Then, the winding operation as described above is also applied to third winding spool $52A_3$ of reel member 50A.

Thus, a film package 70A is obtained in which film 2 is wound around each winding spool 52A with exposed parts of release film 2a of film 2 being passed from flanges 51A to winding spools 52A as shown in FIG. 25 (a), (b) by applying the method for winding a film according to the present embodiment to reel member 50A.

FIG. 27 to FIG. 30 show how a film is wound around another reel member of the present invention according to the method for winding a film according to the present embodiment.

This method uses a reel member assembly comprising a plurality of reel members 50K according to the ninth embodiment described above (hereinafter simply referred to as "reel member 50K").

The present embodiment is described below essentially about the effect resulting from the difference in shape between reel member 50K and reel member 50A, though the winding method itself is similar to the winding method using reel member 50A according to the first embodiment described above.

FIG. 27, FIG. 29 and FIG. 30 correspond to FIG. 22 (a), FIG. 23 (a) and FIG. 24 (a), respectively.

In the present embodiment, reel member 50K itself is slid and then rotated when film 2 is on the point of entering into first guide groove 53K after film 2 has been wound around one of winding spool 52K, as shown in FIG. 27. Thus, film 2 comes into contact with guide edge 54K while straddling flange 51K.

As reel member 50K is further rotated, film 2 moves into the direction in which the contact point 2c with guide edge 54K toward first retaining groove $57K_1$ while unrolled part 2d of film 2 moves toward second retaining groove $57K_2$, as shown in FIG. 28.

Then, film 2 is caught across the edges of two flanges 51K while it touches the bottom of second retaining groove $57K_2$ and sinks in first retaining groove $57K_1$, as shown in FIG. 29.

Then, film 2 is wound around the next winding spool 52K while it is tensioned between first and second retaining grooves $57K_1$, $57K_2$, as shown in FIG. 30.

Other embodiments of methods for winding a film according to the present invention are explained below.

For example, at least one empty winding spool 52 can be interposed between a winding spool 52 around which a film 2 has been wound and the next winding spool 52 around which film 2 is to be wound, i.e., the film 2 can be wound with an interval of one winding spool 52 according to the present invention, in order to protect the film from folding when it is passed over any of the reel members 50A-50L according to the first to tenth embodiments.

According to such an arrangement, the film 2 can be passed between a flange 51 for drawing out the film 2 from a winding spool 52 around which the film 2 has been wound and a flange 51 for winding the film 2 around the next winding spool 52 at a gentler angle as compared with the case when the film 2 is wound around all winding spools 52.

However, this method is preferably applied to reel member 50F according to the sixth embodiment described above.

In this case, film 2 is passed against the curved surface in guide groove 53F of flange 51 and wound around the next winding spool 52F after it is sunk in retaining groove 57F in guide groove 53F of another flange 51F next but one winding spool 52F.

Thus, a film package 70B is obtained in which film 2 is passed at a gentler angle as shown in FIG. 26 by applying the method for winding a film called skipping method described above to reel member assembly formed of a plurality of reel members 50F connected to each other.

According to another embodiment of a method for winding a film, a film can be wound with a reel member having a spacer for passing the film between winding spools on the feeding side and receiving side in order to smoothly pass the film without folding.

In this case, reel member 50L according to the tenth embodiment shown in FIG. 12 (a) is preferably used, for example, in order to evenly balance the weight.

When this reel member 50L is used, it is necessary to shift the timing of passing the film, i.e., the timing of sliding each winding spool 52L by 90 degrees.

According to another embodiment of a method for winding a film wherein reel member 50A according to the first embodiment shown in FIG. 1 is applied to the multistage winding system 1 described above, the rotation of reel member 50A can be stopped when entry 2b of release film 2a on the feeding side approaches guide edge 54A of second flange $51A_2$ at the stage when adhesive film 2 has been wound around first winding spool $52A_1$. Following treatments are similar to the above-described method of winding.

In this case, release film 2a is caught at guide edge 54A of second flange $51A_2$ while reel member 50A is axially moved after the rotation of reel member 50A is stopped.

In the case where any one of reel members 50B, 50C or 50E according to the second, third or fifth embodiment shown in FIG. 3, FIG. 4 (a), (b) or FIG. 6 (a), (b) is applied to the multistage winding system 1 described above, the shape and size of each guide groove 53B, 53C, 53E are different as compared with the case where reel member 50A according to the first embodiment is applied.

Therefore, the timing of stopping the rotation of reel member 50 must be changed when reel members 50B, 50C, 50E according to these second, third and fifth embodiments are used.

However, the other operations are similar to those of the first embodiment, e.g., release film 2a is transferred through guide groove 53 in second flange 51 to second winding spool 52 and then wound around it by catching it at its guide edge 54 or release film 2a is transferred to second winding spool 52 by catching it at guide edge 54 of second flange 51 and then wound around it at the stage when adhesive film 2 has been wound up around first winding spool 52.

When reel member 50D according to the fourth embodiment shown in FIG. 5 (a), (b) is applied to the multistage winding system 1 described above, the range of the timing of stopping the rotation of reel member 50D can be wider as compared with the previous

embodiments because release film 2a can be caught at guide edge 54D of engaging projection 56D after it is slid on the outer periphery of each flange 51D as it rotates.

The present embodiment is similar to the previous embodiments in that release film 2a is passed at the periphery of engaging projection 56D of each flange 51D and caught at guide edge 54D.

According to still another embodiment of a method for winding a film, reel member 50 can be continued to rotate during axial movement of reel member 50 more slowly than during winding.

In this case, the rotation speed of reel member 50 is determined consideration that release film is passed through guide groove 53 in each flange 51 or release film 2a is caught at guide edge 54 of each flange.

According to still another embodiment of a method for winding a film using any of reel member 50G, 50H according to the seventh or eighth embodiment shown in FIG. 9 or 10, a film has been wound around one winding spool 52 and then can be retained near the winding spool 52 by dropping it in retaining groove 57 along guide edge 54 of flange 51.

According to the seventh embodiment, the film is wound around winding spool 52G while it is in contact with the edge of retaining hole $57G_2$ under tension with the position being changed in retaining hole $57G_2$ because it is blocked by anchor $57G_3$ and thereby restrained from movement in retaining hole $57G_2$ as reel member 50G rotates.

According to the eighth embodiment, the film is fixed at the bottom of retaining groove 57H and by interposing between the inner walls of retaining groove 57H and wound around winding spool 52H while it is tensioned from this fixed part as reel member 50H rotates.

In the present invention, retaining grooves 57G, 57H in these reel members 50G, 50H as well as retaining grooves 57F, 57K in the previous reel members 50F, 50K can be used not only to automatically retain the film to flange 51 when it is wound at multiple stages

but also these retaining grooves 57 can be used to retain the film to flange 51 when the film is manually passed though only the step of winding that the film is automatically performed.

When the film is manually passed, however, retaining groove 57 alone suffices without guide groove 53 because guide groove 53 in flange 51 is not required to perform the original function of automatically passing the film but merely required as a working hole for affixing the head of a film to winding spool 52 or inserting the film into retaining groove 57.

In the present invention, therefore, retaining groove 57 is included in the concept of guide groove 53 so far as they are broadly common in passing the film over flange 51. For example, reel members 50F, 50G, 50H may not be provided with guide groove 53 but retaining groove 57 alone as "guide groove" and reel member 50K may be provided with retaining groove 57 including the shape of guide groove 53 as "guide groove".

According to the embodiment described above, a long film can be wound at multiple stages within such a diameter that adhesive cannot be squeezed out of the film because the adhesive film is wound around winding spool 52 of reel member 50 and then the rotation of reel member 50 is stopped (or slowed), after which reel member 50 is axially moved, whereby winding of the film around the next winding spool 52 can be smoothly started, after as described above.

A long film can be more effectively wound at multiple stages by using reel members 50 shown in the first to tenth embodiments when the present embodiment of film winding method is carried out.

According to the first to third and fifth to tenth embodiments wherein each flange 51 has guide groove 53, a film is passed through guide groove 53 at the stage when the film has been wound up around a one of winding spool 52 so that the film can be smoothly moved to the next winding spool 52.

Especially, a film can be wound around the next winding spool 52 without slack by catching the film at the edge (guide edge) of guide groove 53 according to the first to third

and fifth embodiments or by catching the film while it is retained in retaining groove 57 according to the sixth to ninth embodiments.

Guide groove 53 in flange 51 also has the advantage that a film can be wound without running off the outer periphery of each flange 51 or the length of film (release film) to be passed from one winding spool 52 to the next winding spool 52 can be reduced by extending guide groove 53 to the vicinity of winding spool 52 as in the second, third, fifth and ninth embodiments or extending the retaining groove to the vicinity of the winding spool as in the seventh and eighth embodiments.

The fourth embodiment having projection 56 on each flange 51 has the advantage that not only a film can be smoothly moved from one winding spool 52 to the next winding spool or caught at projection 56 but also the range of the timing of performing this can be wider.

According to the second to ninth embodiments wherein reel members 50 are axially connectable to each other, a long film can be handled as appropriate by adjusting the number of reel members 50 depending on the length of the film.

According to the first to ninth embodiments wherein each guide groove 53 or each projection 56 is provided at the same position on the periphery of flange 51, the film can be axially moved or caught at the same timing between flanges 51.

According to the sixth embodiment wherein flange 51 has a certain thickness and guide groove 53 has a curved inner surface along which the film is passed, the film can be prevented from folding when it is passed.

Especially when a film winding method called skipping method is applied to such a reel member 50, the film can be more effectively prevented from folding.

According to the sixth to ninth embodiments wherein retaining groove 57 is formed on guide edge 54 of guide groove 53 to automatically retain the film at flange 51, the film can be prevented from slacking when it is passed.

Especially according to the ninth embodiment wherein not only the film to be wound around winding spool 52 but also the outer part of the already wound film can be retained, the film can be more effectively prevented from slacking.

The sixth to ninth embodiments are advantageously suitable for winding a thin film because a minimum necessary tension can be applied to the film once the film is retained in retaining groove 57 though even the first to fifth embodiments can prevent slacking of a film by winding the film around winding spool 52 while it is caught at a corner or the bottom of guide groove 53 provided that a certain amount of tension must be continuously applied to the film so that the film cannot be moved from the part of guide groove 53 at which it is caught.

According to the eighth and ninth embodiments wherein the center of gravity of flange 51 itself is located on winding spool 52, the film can be evenly wound under a necessary minimum tension because reel member 50 having such a flange 51 in its structure can be rotated at a constant moment of rotations.

The film package 70 comprising such a reel member 50 around which a film has been wound can be delivered in various forms because it is stable with the center of gravity as a whole being located on winding spool 52.

According to the tenth embodiment, a long film can be wound always at a constant moment of rotations by evenly balancing the weight of reel member 50L and the long film can be wound without folding by spirally guiding and smoothly passing it, with the result that a film package 70C containing a film without creases (without waste) can be provided to clients.

Especially in this embodiment, the length of the film that can be wound at multiple stages can be further increased while maintaining an even weight balance by increasing the number of winding spools 52L and flanges 51L per a unit number n determined in terms of the weight balance.

When a film of 50 m is wound around a winding spool 52L, for example, the length of the film that can be wound with reel member 50L is a unit number n (=4) multiplied by an integer N, i.e., 200 x N meters ("x" means multiplication).

## ADVANTAGES OF THE INVENTION

It is apparent from the foregoing description that the present invention is adaptable for winding a long adhesive film at multiple stages in such a diameter that adhesive cannot be squeezed out and a reel member that can be applied to this method can be obtained.